

## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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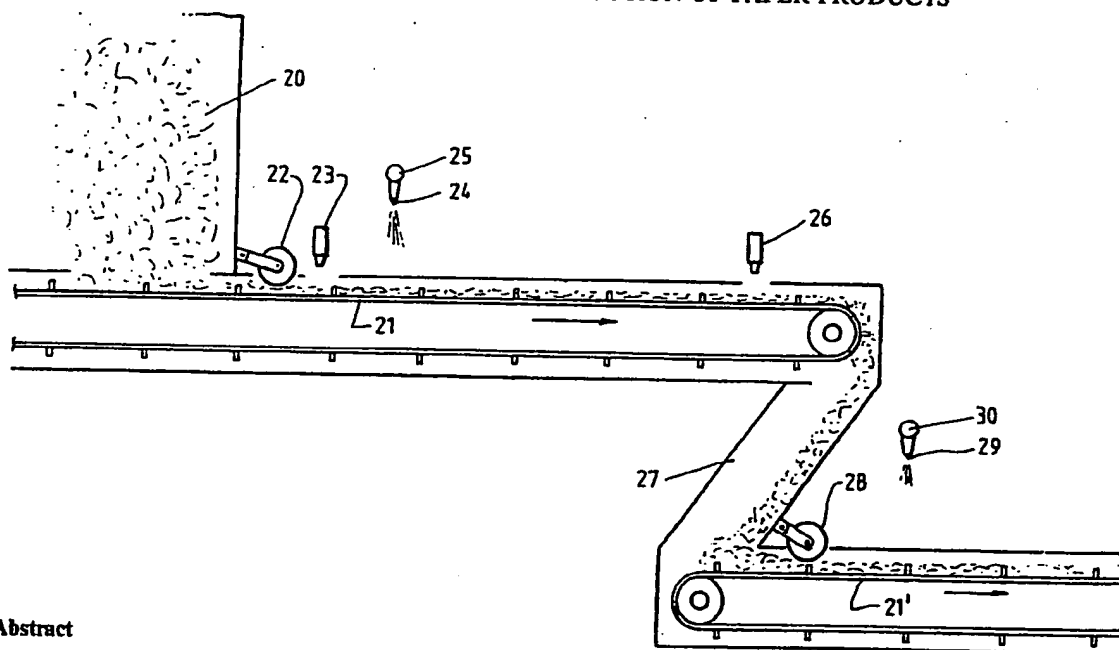
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Published

With international search report.

(54) Title: PROCESS AND APPARATUS FOR THE PRODUCTION OF PAPER PRODUCTS



(57) Abstract

A process and an apparatus for the production of paper products, such as "cat litter" or paper fuel, comprising reducing paper to a particulate form by shredding and grinding, conveying the particles of paper as a layer on a first conveyor (21) firstly beneath a first levelling and compacting roller (22) and thereafter beneath a first set of water sprays (24), before discharging from the conveyor onto a second conveyor (21') through a rearwardly inclined transfer chute (27) to invert the layer during transfer. The inverted layer on the second conveyor passes firstly beneath the second levelling and compacting roller (28) and thereafter the extruded mix into pellets before subjecting the pellets to dehydration. In the case of paper product to be used as paper fuel, the paper is mixed with coal dust.

# + DESIGNATIONS OF "SU"

It is not yet known for which States of the former Soviet Union any designation of the Soviet Union has effect.

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PROCESS AND APPARATUS FOR THE PRODUCTION  
OF PAPER PRODUCTS

Technical Field

This invention relates to a process and apparatus for the production of paper products, such as moisture absorbing products or a combustible paper fuel.

In the case of a moisture absorbing product, such may be capable of absorbing liquids without losing its shape, and in particular, but not exclusively, such a product in a pelletised form. One embodiment of the invention has been particularly developed for use as "cat litter" although it may be used for other purposes where its moisture absorbing properties are required.

Background Art

The majority of products presently available for use as "cat litter" or for other moisture (liquid) absorbing purposes, are formed from clay based materials

and are non-organic with the resulting problem that they will not decompose. In addition they have the added disadvantage of depositing clay powder on the paws of cats which is subsequently transferred to floor surfaces leaving tracks. In addition such products result in the continued use of mineral resources whilst more recently certain cultivated pasture crops have been unnecessarily harvested and used merely for the purposes of "cat litter".

In the case of paper fuel it may be composed of a relatively high percentage of paper. Whilst paper combusts readily it can not be used in its basic form as it either burns too quickly in its loose sheet form or will not burn satisfactory when in the form of a thick mass. In addition, it is important to consider the physical transportation of recyclable paper in its normal form from collection zones to points of use for heating and/or cooking.

As a result of a heightening of community awareness, the supply of paper for recycling has increased to such a degree that it, in many cases, far exceeds the demand for conventional products made from such recycled paper, and as a result the excess is disposed of by landfilling or exported usually at the cost of the country.

#### Disclosure of the Invention

It is therefore one object of the present invention to utilize surplus recycled non-toxic paper in a form convenient for moisture absorbing purposes, such as "cat litter" and which is also convenient for the purposes of ease and cleanliness of handling, packaging and storage.

It is also an object of the present invention to utilise surplus recycled non-toxic paper in a form convenient and effective for domestic, commercial and industrial heating and/or cooking, and which also provides for ease and cleanliness of handling, packaging and storage.

The invention envisages a process for producing a paper product of the type defined above, including the steps of reducing paper to particulate form, mixing the particles of paper with water, subjecting the mix to pressure to form a compacted mass which is subsequently

subjected to dehydration to reduce the moisture content.

Preferably the paper is reduced to a particulate form by grinding.

The invention also envisages an apparatus for carrying out the process defined above.

The invention still further envisages a paper product resulting from the process and apparatus defined above.

#### Brief Description of the Drawings

In one embodiment of the invention the process and apparatus produces a paper product for use as a moisture absorbing medium.

In another embodiment the process and apparatus produces a combustible fuel formed primarily from particles of compressed paper combined at least with coal dust.

Preferably, in the case of a combustible fuel, a proportion of calcium oxide is also added to the mix.

One preferred embodiment of the process and apparatus of the invention will now be described with reference to the accompanying drawings, in which;

Figure 1 is a flow diagram showing a process for producing a paper product which may be a moisture absorbing paper product or a paper fuel,

Figure 2 is a side elevational view of part of an apparatus for carrying out the process of the invention, and

Figure 3 is a plan view of the part of the apparatus of Figure 2.

#### Best Mode for Carrying out the Invention

In this preferred embodiment of the invention, as applied to producing a moisture absorbing product, the recycled paper used is primarily newsprint which is ground in available paper grinding equipment down to a paper fluff suitable for subsequent compression and binding. Water is then added to the paper fluff to achieve an overall water content of between 25 - 30%.

The mixture of paper and water is then extruded under high pressure, thought to be in excess of 2,000MPa, and then divided into moisture absorbing pellets having a surface area of between 110 mm<sup>2</sup> and 210 mm<sup>2</sup> and a length of

between 5 mm and 15 mm.

The pellets are then finally dehydrated by a drying process to reduce their moisture content to something less than 10%.

The resultant pellets are capable of absorbing in excess of twice their own weight of water without substantially changing their shape and are also substantially free of paper dust. After use, for example as "cat litter", the pellets can be readily disposed of by digging into soil as an organic, decomposable, non-toxic soil conditioner, or flushed into sewerage systems.

Other suitable uses of the pellets is as water retention masses and soil conditioners to aid the cultivation of plants.

As applied to paper fuel the particle size produced from the grinding operation should be such as to range from paper fluff to particles having a surface area up to  $5 \text{ cm}^2$  whilst the fluff should not be less than 30% of the total paper mix.

The ground paper is then mixed with coal dust, calcium oxide and water. The coal dust can be a by-product of the manufacturer of briquettes, and may range in particle size up to 1.5 mm in diameter and blended with the ground paper in the ratio between 2:1 and 4:1 paper to coal dust. The calcium oxide component should be 1 part per 100 of the paper and coal mix and sufficient water added to result in a moisture content for the mix of between 25 to 30%.

The above mixture is then extruded under high pressure, thought to be in excess of 2,000MPa, and divided into units of fuel having a surface area between  $60 \text{ cm}^2$  and  $100 \text{ cm}^2$ , with a length between 3 cm and 6 cm and a mass in excess of  $1.00 \text{ gms per cm}^3$  of dry weight.

The extruded units are then finally dehydrated by a drying process to reduce the moisture content of the units for something less than 13.5%.

The resultant combustible fuel is in effect clean, readily packaged units suitable for domestic, commercial and/or industrial purposes, such as for heating, and the blend of the mixture and the degree of compression is such

as to have an overall energy value of 15 MJ/kg.

With reference to Figure 1 of the drawings, and in accordance with this preferred embodiment of the invention, the process as applied to the production of a moisture absorbing paper product, or a predominantly paper based combustible fuel, involves taking raw material (waste paper) from a storage 10, passing it through a preliminary sizing process 11 to reduce the waste paper to a manageable size for subsequent grinding in a grinding plant 12 to paper fluff. The paper fluff is subsequently aspirated at station 13, whereafter the fluff is settled at 14 and subsequently conditioned by application of water at 15. The conditioned paper product is then transferred to extruding equipment 16 where it is extruded in a pellet mill 16 into a continuous length and cut to individual pellet lengths, before being dried in a dryer 17. The process is completed by a sizing operation at station 18 to remove undersized and oversized pellets (including dust particles), for subsequent transfer to a finished product despatch station 19.

Figures 2 and 3 of the drawings show the part of the apparatus for carrying out the aspiration, settling and conditioning steps of the process, and comprises a storage bin 20 from which ground paper gravitates as a layer onto the upper run of a first stage conveyor belt 21 driven to run at a speed of in the order of 1 metre per second and then beneath a first pivoted leveling and pressurising roller 22 which serves to compact the layer of ground paper on the conveyor belt 21 to a thickness of between 10 to 20 mm. Because of the pivoted support for the leveling and pressurising roller 22, it is free floating to ride over larger objects or masses of material. The compacted paper fluff is then passed on the conveyor belt 21 beneath a first flow sensor 23, in the form of a micro-switch, which confirms that there is a layer of material on the conveyor belt 21.

The material on the first stage conveyor belt 21 then passes beneath a first set of spraying jets 24, supplied with water through a supply conduit 25, and only operable if the first flow sensor 23 has detected the

presence of material on the conveyor. The moistened (conditioned) material on the conveyor belt then moves beneath a second flow sensor 26 which confirms that there is still a layer of material on the conveyor belt 21, and then gravitates through a rearwardly inclined transfer chute 27 to a second stage conveyor belt 21' and in the process the material is inverted to expose the opposite side of the material to firstly a second free floating pivoted leveling and pressurising roller 28 and thereafter a second set of spraying jets 29, also supplied with water through a supply conduit 30, and the aspirated, settled and conditioned mass of paper fluff is then transferred to the extruder where it is extruded and cut to the required pellet size, before drying and sizing.

In the case of paper fuel, the ground paper, before being supplied to the storage bin 20, is mixed with a proportion of coal dust and a proportion of calcium oxide, and the mixture is thereafter subjected to aspiration, settling and conditioning in the apparatus shown in Figures 2 and 3.

Modulator valves (not shown) control the volume of water sprayed onto the material by the spraying jets 24 and 29 above both the first and second stage conveyor belts 21 and 27, and the volume of the sprays is controlled to be dependent on the speed of the respective conveyor belts.

As shown in the drawings, each of the conveyor belts 21 and 27 have a plurality of spaced apart cleats 31 extending transversely of their length which serve to not only assist in conveying the material, but also to control the thickness of material between the preferred limits of 10 to 20 mm.

In relation particularly to a moisture absorbing paper product, the process of this preferred embodiment of the invention can achieve bulk densities of product up to  $660 \text{ kg/m}^3$  with a relatively slow throughput, and less friable for use as a "cat litter" for example, whilst in relation to a low density product capable of rapidly absorbing floor spills, such as oils, bulk density of between  $300$  to  $500 \text{ kg/m}^3$  are desirable.



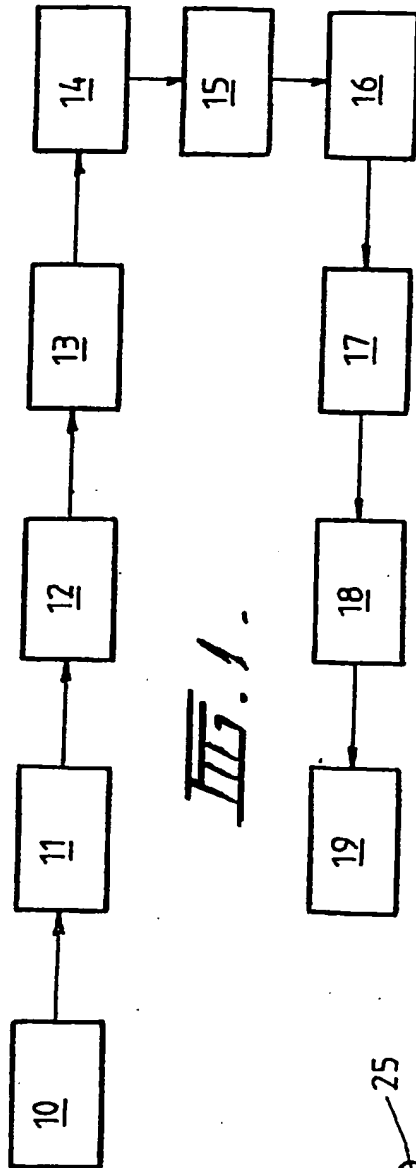
## CLAIMS

1. A process for producing a paper product, including the steps of reducing paper to a particulate form, mixing the particles of paper with water, subjecting the mix to pressure to form a compacted mass which is subsequently subjected to dehydration to reduce the moisture content.
2. A process as claimed in Claim 1, wherein the water is added to the particles of paper as they move as a layer of material on a first conveyor, and also whilst moving on a second conveyor after being transferred thereto in a manner which involves inversion of the layer.
3. A process as claimed in Claim 1 or 2, wherein the paper is reduced to particulate form by grinding to produce particles in the form of paper fluff.
4. An apparatus for producing paper product, including means to reduce paper to a particulate form, means for mixing the particles of paper with water, means to apply pressure to the mix to form a compacted mass, and means to dehydrate the compacted mass.
5. An apparatus as claimed in Claim 4, wherein the means to reduce the paper to particulate form includes a grinding means to produce particles in the form of paper fluff.
6. An apparatus as claimed in Claim 5, wherein the means to reduce the paper to particulate form also includes means to shred the paper prior to grinding.
7. An apparatus as claimed in any one of Claims 4 to 6, wherein the means to add water to the particles of paper includes a first and a second conveyor, along which the paper particles move as a layer with the layer being discharged from the leading end of the first conveyor onto the trailing end of the second conveyor in a manner which results of inversion of the layer, and spraying means to, whilst said layer is on said conveyors, subject the layer to controlled sprays of water.
8. An apparatus as claimed in Claim 7, wherein rollers are disposed above each of said conveyors to level and compact said layer.

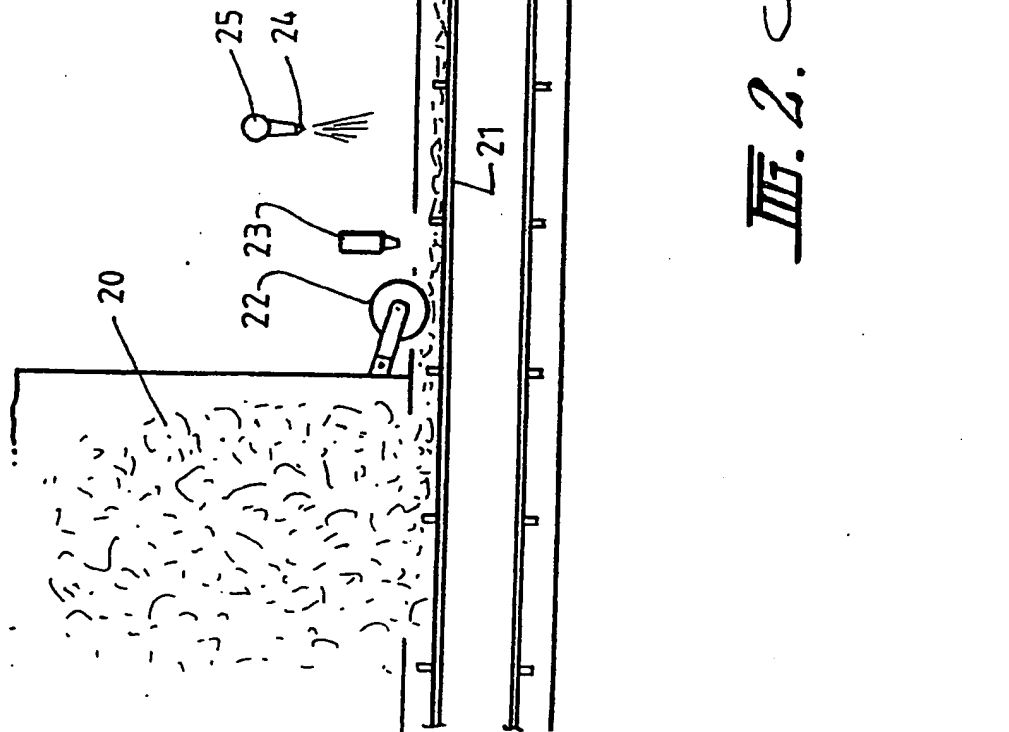
9. An apparatus as claimed in Claim 7 or 8, wherein sensors are disposed above said first conveyor to sense the presence of a layer thereon and actuate said spraying means accordingly.

10. A paper product manufactured in accordance with the process of Claims 1 to 3, using an apparatus in accordance with Claims 4 to 9.

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III.1.



III.2.c

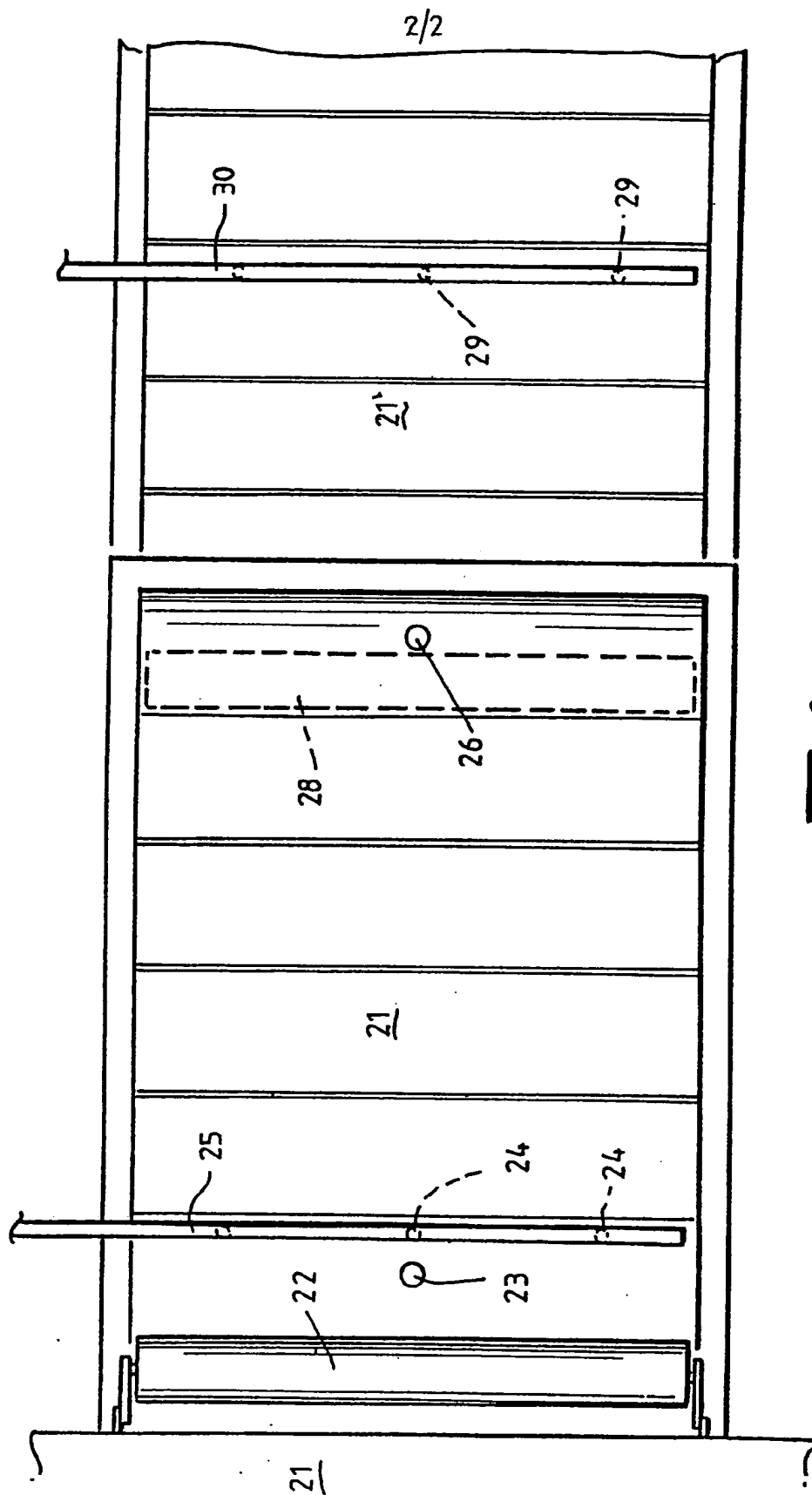


Fig. 3.

# INTERNATIONAL SEARCH REPORT

## I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all)<sup>6</sup>

According to International Patent classification (IPC) or to both National Classification and IPC  
Int. Cl.<sup>8</sup> D21B 1/08, D21C 5/02

## II. FIELDS SEARCHED

Minimum Documentation Searched <sup>7</sup>

Classification System

Classification Symbols

IPC

D21B 1/08, D21C 5/02

Documentation Searched other than Minimum Documentation  
to the extent that such Documents are included in the Fields Searched <sup>8</sup>

AU : IPC as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT <sup>9</sup>

Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate of the relevant passages <sup>12</sup>	Relevant to Claim No <sup>13</sup>
X,Y	FR,A, 1582002 (BELOIT CORP) 26 September 1969 (26.09.69) See claims	(1, 3-6, 10)
X,Y	FR,A, 2384060 (HATANAKA) 13 October 1978 (13.10.78) See pages 3-6, Figs 2-3	(1, 3-6, 10)
Y	WO,A, 90/04677 (BRODRENE HARTMANN) 3 May 1990 (03.05.90) See claims	(1, 3-6, 10)
Y	US,A, 3994770 (LAUSCH) 30 November 1976 (30.11.76) See claims 1, 5, 12	(1, 3-6, 10)
(continued)		

\* Special categories of cited documents : <sup>10</sup>

- "A" Document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" Later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

## IV. CERTIFICATION

Date of the Actual Completion of the International Search  
10 October 1991 (10.10.91)

Date of Mailing of this International Search Report

18 October 91

International Searching Authority

AUSTRALIAN PATENT OFFICE

Signature of Authorized Officer

J.M. SELLARS

**FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET**

X,Y	EP,A, 289015 (POTTINGER A. MASCH) 2 November 1988 (02.11.88) See Legend, Figs.	(1, 3-6, 10)
X,Y	WO,A, 88/08466 (POTTINGER A. MASCH) 3 November 1988 (03.11.88) See Legend, figs.	(1-6, 10)
X,Y	DE,A, 3718541 (HENTSCHEL) 22 December 1988 (22.12.88) See Whole document	(1, 3-6, 10)
X,Y	Derwent Abstract Accession no. 84-229177/37, Class F09, JP,A, 59-0137586 (MITSUBISHI PAPER MILL) 7 August 1984 (07.08.84)	(1, 3-6, 10)

**V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE <sup>1</sup>**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

- ☐ Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:
- ☐ Claim numbers ..., because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
- ☐ Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4a

**VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING <sup>2</sup>**

This International Searching Authority found multiple inventions in this international application as follows:

- ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
- ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
- ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

**Remark on Protest**

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

**ANNEX TO THE INTERNATIONAL SEARCH REPORT ON  
INTERNATIONAL APPLICATION NO. PCT/AU 91/00308**

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
FR	1582002	DE	1561619		
FR	2384060	JP	53113383		
WO	90/04677	AU	44981/89	BR	8905453
		CN	1042390	DK	5922/88
		GB	2242445	NL	8921149
				CH	678537
				EP	440714
US	3994770	AT	4334/74	JP	50048202
				SE	7409178
EP	289015	DE	3714587		
WO	88/08466	DE	3714624	EP	335916

END OF ANNEX

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